Determination of Vitamin C and Mineral from Spinach *(Amaranthus Viridis)* Chips for Nutrient Facts

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Abstract

Spinach is one of the vegetables that contained lots of nutrients and vitamins which is good for human health. Every 100 g of raw green of spinach give 22 kcal of energy. It also contribute nutrient amount of vitamin A, B complex, C, E, K, carotenes, folate, manganese (Mn), calcium (Ca), iron (Fe), protein, potassium (K), carbohydrates and amino acids. Spinach contains anti cancerous food. So it can be used to prevent cancer, control cholesterol level, combat anemia and acidosis, eye problems, high blood pressure and bleeding gums. The objectives of this study are to introduce spinach chips as nutrient food for children and adults, to increase food production based on vegetables and to provide nutrient facts by the determination of Vitamin C, Fe, Ca and K in spinach chips. The study involved the preparation of 100 g spinach (*Amaranthus Viridi)* chips and the analysis of Vitamin C using AOAC 967.21 test method and also the determination of mineral such as Fe, Ca and K using Atomic Absorption Spectrophotometer (AAS). The results showed that the composition of vitamin C, Fe, Ca and K were 0.31 %; 1.76%; 52.34 % and 45.59 % respectively. The total vitamin and minerals amount of nutrients were 4.8 mg/ 100 g for vitamin C, 814 mg/ kg for Ca, 27.4 mg/ kg for Fe and 709.8 mg/ kg for K. It was found that, spinach contained nutrients value even though it was cooked as chips. High nutrients value especially in vitamin C and minerals provide health benefits to human bodies.

Keywords: Spinach, Minerals, Vitamin, AAS, nutrient value, health

1. INTRODUCTION

Spinach (*Spinacia oleracea*) is an edible flowering plant in the family of Amaranthaceous. It is the most important leafy vegetable and also an important source of minerals. According to (Lisiewska *et al.*, 2011), the age to leaves will determine the chemical composition of the spinach. Every 100 grams of spinach will provide 22 kcal of energy. Spinach contains lower calories, vitamin C, vitamin A and minerals especially iron (Toledo et al., 2003). It also contains very good amount of vitamin B complex, E, K, carotenes, folate, manganese, calcium, iodine, magnesium, phosphorus, protein, potassium, sodium, carbohydrates, amino acids and a lot of water.

Spinach always available every year and never finished. There are varieties type of spinach which is Amaranthus paniculatus, Amaranthus gangeticus, Amaranthus blitum and Amaranthus viridis (I. Amin *et al.*, 2004).

Nowadays, there are a lot of food product that have been produce and distribute to the consumers. But, the food product that used vegetables as the main ingredient is less. This situation occur because less research have been done to discover the advantages and benefits that human can get when they it this vegetables in their daily life although in small quantity.

This problem also will give difficulties for the vegetarian people who just eat vegetables have difficulty to find and choose their food. So, this research will give them variety of food to choose.

The aims of this research are to study the composition of Vitamin C, iron, calcium and potassium that contain in spinach chips and to introduce spinach chips as nutrient food.

2. MATERIALS AND METHODS

SAMPLES COLLECTION & PREPARATION

The study was carried out at the laboratory in Faculty of Industrial Sciences & Technology, Universiti Malaysia Pahang. Spinach chips samples will be purchased from a few factory that produce spinach chips. The samples will purchased after it if have been produce as a chip. For analysis composition of vitamin C in spinach chips, the determination must be done very quickly to avoid the instability of vitamin C. The samples to be use in the determination of iron, calcium and potassium are heated in the crucible until it's completely become ash. While for analysis of composition of vitamin C, the spinach chips samples is ground by using mortar.

Figure 1: Sample of Spinach chips

Preparation of spinach chips for vitamin C analysis

Vitamin C was extracted accordingly to the method AOAC 967.21. In this method, vitamin is extracted and titration performed in the presence of metaphosphoric acid.

10g sample in 250 ml conical flask were mixed in metaphosphoric acid-acetic acid solution and make up to volume of 200ml. The sample was homogenized by using a magnetic stirrer. The sample was filtered and 10 ml of sample was filled in 100 ml conical flask for titration using dye.

Preparation of sample for metal analysis

For metal analysis, test method involved is microwave digestion for the preparation of liquid sample and analysis of metal using Atomic Adsorption Spectrophotometer (GBC 906 Elite) Operator Manual.

About 0.5 g of dry sample was placed in TFM vessel and 3 ml of nitric acid 60% and 2 ml of hydrogen peroxide 30% were added in that vessel. The process was take place about 30 minutes. After the digestion process, sample was diluted with deionized water and analyzed using AAS (flame).

3. RESULTS AND DISCUSSION

The measured results of the concentrations of metals (Ca, Fe, and K) and vitamin C in samples are showed in Table 1.

Table 1: Analysis results for metals and vitamin C in Spinach's sample *(nutrient value)*.

Parameter	Unit	Result
Calcium (Ca)	mg/ kg	814.9
Iron (Fe)	mg/ kg	27.4
Potassium (K)	mg/ kg	709.8
Vitamin C	mg/ 100g	4.8

The results showed that the composition of vitamin C, Fe, Ca and K were 0.31 %; 1.76%; 52.34 % and 45.59 % respectively. The total vitamin and minerals amount of nutrients were 4.8 mg/ 100 g for vitamin C, 814 mg/ kg for Ca, 27.4 mg/ kg for Fe and 709.8 mg/ kg for K.

Vitamin C

If compared with raw vegetables of spinach, the amount of vitamin C is 130 mg/ 100 g which is high if compared with spinach chips. This may be due to some changes during the cooking process.

Table 2 shows the amount of vitamin C in three types of raw vegetables. It was found that, all vegetables contain high amount of vitamin C. The highest amount of vitamin C is found in spinach.

Table 2: Amounts of vitamin C in three types of vegetable.

VEGETABLES	VITAMIN C (mg/100g)
Spinach	50-90
Potatoes	10-30
Peas	10-30

From this study, it was found that, spinach is one of vegetables that contain vitamin C that is very useful for nutrient value. The health effects of vitamin C are antihistamine reaction, affect immune function, protection from inflammation, reduce cardiovascular disease, prevent diabetes, reduce or delay tumor formation and antioxidant protection of the lung (Gerald F. Combs, 2008).

Calcium

In this study, it was found that, spinach chips contain high nutrient value of Calcium. About 52.34% of Ca was determined. This amount can contribute to the human health. Other than milk and any types of food, main source of Ca can be found in spinach chips.

Calcium is an essential macronutrient for humans. It has mainly a structural function in bones and teeth. Several studies have shown that calcium could have in the control of blood pressure, the appearance of colon cancer, pancreatitis and the surrounding vascular tissue.

Potassium

It was found that, spinach chips contain 709.8 mg/ kg of K. Potassium (K) that contain in food plays an important role in cellular and electrical function. It is a predominant positive electrolyte found in body cells. Low potassium levels in human body will lead to hypertension, congestive heart failure, cardiac arrhythmia, fatigue, depression, and other mood changes. Decreasing in the amount of potassium taken in body can cause serious muscles weakness, bone fragility, central nervous system changes, decreased heart rate, and even death (Akhtar *et al*., 2002).

Table 3 shows information on adequate intake of potassium by human.

Table 3: Adequate Intake for Potassium

Life Stage	Age	Males (mg/day)	Females (mg/day)
Children	4-8 years	3,800	3,800
Children	9-13 years	4,500	4,500
Adolescents	14-18 years	4,700	4,700
Adults	19 years and older	4,700	4,700

4. CONCLUSION

It was found that, spinach contained nutrients value even though it was cooked as chips. High nutrients value especially in vitamin C and minerals provide health benefits to human body.

ACKNOWLEDGEMENT

I wish to thank Nazikussabah Zaharudin, Siti Maznah Kabeb and Farahanim Misni for the advises and guideline for sample collection and laboratory measurements. I also wish to acknowledge the help from Science Officer from the Faculty of Industrial Sciences & Technology and Universiti Malaysia Pahang for the supports and foundation.

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